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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B60R 21/26

A1

(11) International Publication Number: WO 94/25315

(43) International Publication Date: 10 November 1994 (10.11.94)

(21) International Application Number: PCT/US94/03839

(22) International Filing Date: 7 April 1994 (07.04.94)

(30) Priority Data:
08/054,601 29 April 1993 (29.04.93) US

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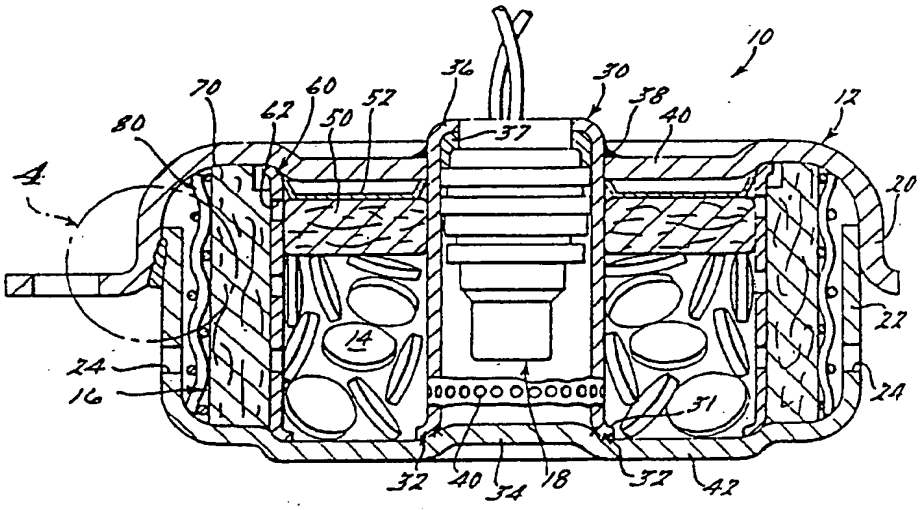
(81) Designated States: CA, JP, KP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: INFLATOR HAVING A RUPTURABLE IGNITER TUBE



(57) Abstract

An inflator (10) for an inflatable vehicle occupant restraint system includes a housing (12) having at least two spaced walls (20 and 22) that are connected by a structural member (30) that normally maintains the spaced relationship. The structural member (30) serves as an igniter tube for supporting an igniter (18) therein, and is rupturable upon the occurrence of relatively high gas pressures internally of the housing to permit expansion of the housing (12) to increase its volume and reduce the gas pressure therein.

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INFLATOR HAVING A RUPTURABLE IGNITER TUBE

BACKGROUND OF THE INVENTION

It is now apparent that inflatable vehicle occupant restraint devices, generally known as "airbags," save lives. Increased utilization of this life saving product has accentuated the search for a smaller, lighter, less expensive inflatable restraint system. Since the inflator used in such inflatable occupant restraint systems is the largest, heaviest and one of the most expensive components of the system, it is now receiving close attention.

The combustion pressure of a propellant is related to ambient temperature and pressure conditions. Thus, conventional airbag inflators are relatively thick walled due to the fact that wall thickness must be sized to contain the maximum gas pressure exhibited under the most adverse condition.

Conventional inflators incorporate an internal filter to prohibit solid and liquid combustion products from entering the restraint bag. To properly filter the combustion gases, known filters generally comprise multiple layers of metal screen which are often combined with fibrous materials. Such known filters are relatively heavy, expensive to manufacture and exhibit inconsistent pressure attenuation.

A typical inflator comprises a cylindrical perforated steel or aluminum housing of a diameter and length related to the application and efficiency of the solid propellant. Typically, one or more layers of steel screen of varying mesh and wire diameter are disposed about an internally disposed propellant so as to form sites upon which liquid combustion products condense and liquify and to trap solids produced incident to combustion. Gases produced in the combustion process pass through the screen. Inflators heretofore known have utilized seals and multiple barriers to preclude bypass of liquids and solid materials between the periphery of the filter and the housing.

SUMMARY OF THE INVENTION

The solution to the problem of reducing airbag inflator size, weight, cost and efficiency, in accordance with the present invention, is predicated on the concept that it is possible to utilize a relatively small and light, thin walled inflator housing if the housing accommodates excessive combustion pressure by expansion, with a resultant volume increase and pressure decrease, rather than containment. To preclude bypassing of combustion products, the filter is sized so as to be compressively sealed by the walls of the inflator housing upon assembly thereof, thereby accommodating the aforesaid expansion of the walls as well as eliminating heretofore required seals.

Further stated, the present invention provides an improved inflator for an inflatable vehicle occupant restraint system comprising a housing having at least two spaced walls, a plurality of apertures in the housing for the discharge of combustion gases, a propellant in the housing, and a filter disposed between the propellant and the apertures in the housing, wherein the improvement comprises a cylindrical structural member extending between and welded to the spaced walls, respectively, of the housing for maintaining the spaced relationship therebetween upon the production of gas under relatively low pressure. The structural member has a plurality of aligned relatively small closely spaced apertures extending circumferentially around the entire periphery thereof, and is rupturable upon the occurrence of a predetermined relatively higher gas pressure in the housing thereby permitting movement of the walls away from one another and expansion of the housing to increase the volume thereof and reduce the gas pressure therein. An igniter is disposed internally within the structural member, wherein the plurality of apertures serve the dual purposes of venting a flame front generated by the igniter to the propellant and exhibiting a predetermined failure mode of the structural member.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of an inflator in accordance with the present invention.

Fig. 2 is a cross-sectional view, similar to Fig. 1, of the inflator housing that has been expanded due to excessive internal pressure.

Fig. 3 is a fragmentary view of the inflator housing and filter prior to assembly.

Fig. 4 is a cross-sectional view taken within the circle "4" of Fig. 1 showing the weld between the housing sections.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

As seen in Fig. 1 of the drawing, an inflator 10, in accordance with a preferred constructed embodiment of the present invention, comprises four major components, namely, a housing 12, a propellant 14, a filter 16, and an igniter 18.

The inflator housing 12 is formed by two dish-shaped sections 20 and 22 that are welded together in inverted nested relationship. The lower housing portion 22 contains a plurality of apertures 24 for the discharge of gas produced by the propellant 14 into an airbag, not shown.

In accordance with one feature of the present invention, the housing 12 is provided with a centrally disposed igniter support tube 30 having a flared lower end portion 31 that is spin or laser welded as at 32, to a complementary boss 34 in the lower housing 22. The igniter tube 30 supports the igniter 18 internally thereof, an upper edge portion 36 of the tube being rolled over a retainer ring 37 to trap the igniter 18. The tube 30 is welded to the upper housing 20 by an annular laser weld 38.

The end of the igniter tube 30 is flared and the wall 34 of the inflator housing portion 22 is raised in the adjoining region to increase the weld interface thus increasing the weld strength. This configuration also reduces the bending movement on the weld joint 32 itself. At the opposite end of the igniter tube 30, the inflator housing portion 20 is axially depressed to provide clearance for the end 36 of the initiator

tube 30 to be crimped over the retainer ring 37 to retain the initiator tube 30 while keeping the inflator height to a minimum yet keeping the filter height to a maximum.

In accordance with another feature of the present invention the igniter tube 30 is provided with a plurality of apertures 40 disposed in a circumferential array at a point underlying the igniter 18. The apertures 40 serve the dual purpose of initially passing a flame front from the igniter 18 to the propellant 14 and, in the event of excessive predetermined gas pressure developed within the inflator 10 due to, for example, extremely hot ambient temperature conditions, facilitating rupture of the tube 30 at the apertures 40 to permit axial expansion of the radial wall portions 42 and 44 of the housing portions 20 and 22, respectively, away from one another as seen in Fig. 2 of the drawings. Expansion of the housing 12 increases the volume thereof reducing internal pressure to a safe level. Accordingly, the housing can be manufactured from a relatively thin, light material, for example steel or aluminum..

As seen in Fig. 1, a wad 50 is disposed above the propellant pellets 14 to preclude excessive movement of the pellets. The wad 50 is held in place by a combination wad retainer and heat shield 52 that is crimped between the igniter tube 30 and a propellant retainer sleeve 60. The retainer sleeve 60 has a plurality of apertures 62 therein for the passage of gas generated by the propellant 14 radially outwardly therethrough.

The perforated filter support tube 60 acts dually as a filter assembly locator during manufacturing and as a precipitation element to reduce particulate emission during operation. The rolled ends of the perforated tube 60 locate the tube 60 and filter 16 in the housing 10 during assembly.

Assembly is also facilitated by the welding shield 52 that is press fit on the central igniter tube 30 so as to act as an assembly to hold the wad 50 and propellant 14 in place during manufacture as the inflator 10.

In accordance with another feature of the present invention, the filter 16 comprises a fine wire mesh annulus that is resiliently axially compressed between the housing portions 20 and 22 upon assembly thereof. Compression of the filter 16 eliminates the requirement for seals at the longitudinal ends thereof to preclude propellant gas bypass. The filter 16 is radially retained by a relatively heavy wire screen 80 that accommodates radial expansion of the filter element 16 due to longitudinal compression upon assembly of the housing components 20 and 22.

The annular resiliently compressible filter 16 made from, for example, fine wire mesh manufactured by Metex Corporation, is used to eliminate the necessity of seals to prevent filter bypass. It is to be noted that initial compression of the filter 16 is greater than maximum expansion of the inflator housing 12 at maximum expected operating pressure.

In accordance with yet another feature of the invention, the upper and lower portions 20 and 22, respectively, of the inflator housing 12 are welded to one another by a laser or electron beam welding process that produces a weld 90 of relatively large axial dimension but of minimum radial dimension. The weld 90 extends longitudinally substantially parallel to the central axis of the inflator 10 thereby to provide a relatively long weld interface between the housing portions 20 and 22. Hoop strength of the housing 12 is maximized at the outer periphery thereof by the nested and welded portions 20 and 22 of the housing 12 thereby eliminating a primary failure mode. Moreover, heat flux into the surrounding metal is minimized by utilizing a laser or electron beam weld, so as to eliminate cooking of the internal components of the inflator 10.

From the foregoing it should be apparent that the inflator of the present invention utilizes the concept of expansion of the inflator housing as combustion gas pressure increases above undesirable levels, for example, to twice maximum expected operating pressure, to reduce such pressure

internally of the housing. Expansion is facilitated by a designed in failure of the igniter support tube 30. The igniter tube 30 fails along flame discharge orifices 40 therein. This failure mode eliminates external discharge of excessively hot gases.

While the preferred embodiment of the invention has been disclosed, it should be appreciated that the invention is susceptible of modification without departing from the scope of the following claims.

WE CLAIM:

1. In an inflator for an inflatable vehicle occupant restraint system comprising a housing having at least two spaced walls, a plurality of apertures in said housing for the discharge of combustion gases, a propellant in said housing, and a filter disposed between said propellant and the apertures in said housing, the improvement comprising:

a cylindrical structural member extending between and welded to the spaced walls, respectively, of said housing for maintaining the spaced relationship therebetween upon the production of gas under relatively low pressure, said structural member having a plurality of aligned relatively small closely spaced apertures extending circumferentially around the entire periphery thereof and being rupturable upon the occurrence of a predetermined relatively higher gas pressure in said housing thereby to permit movement of said walls away from one another and expansion of said housing to increase the volume thereof and reduce the gas pressure therein; and

an igniter disposed internally of said structural member, the apertures in said structural member serving the dual purposes of venting a flame front generated by said igniter to said propellant and exhibiting a predetermined failure mode of said structural member.

Fig. 1.

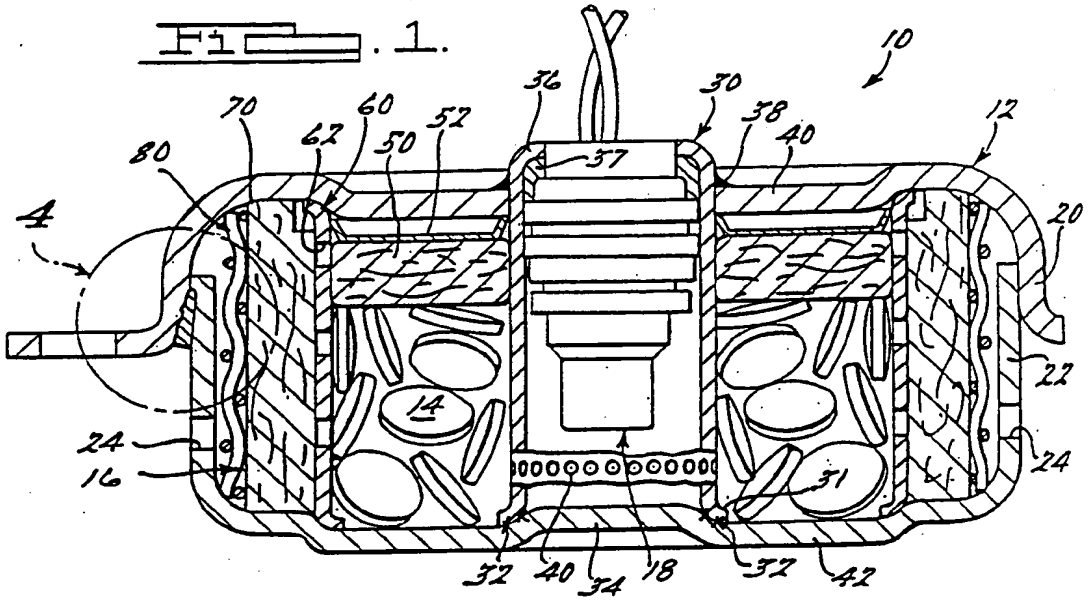
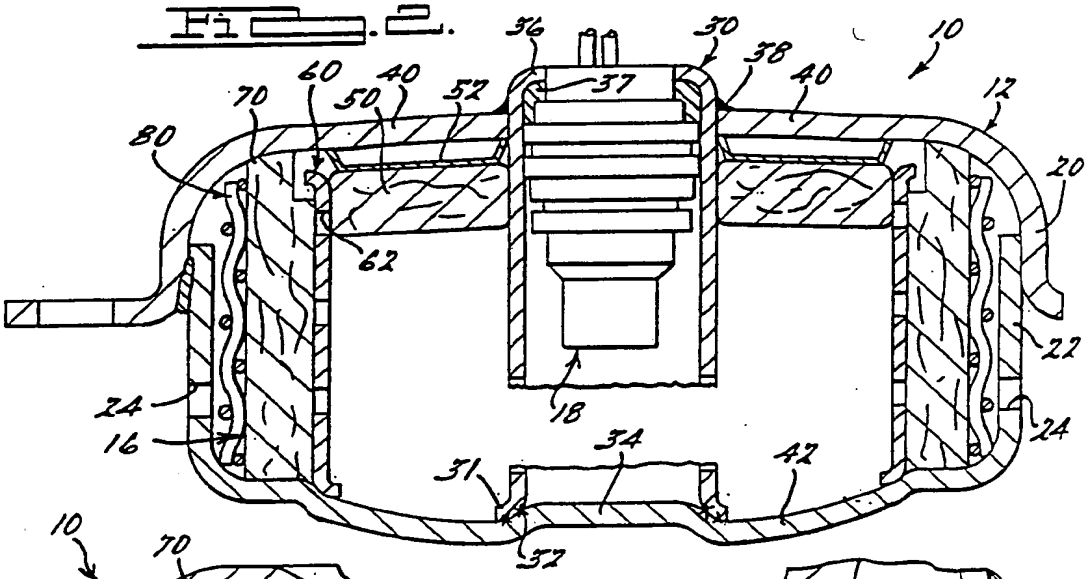


Fig. 2.



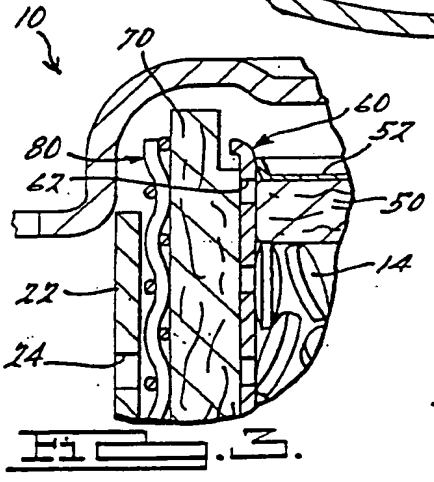


Fig. 3.

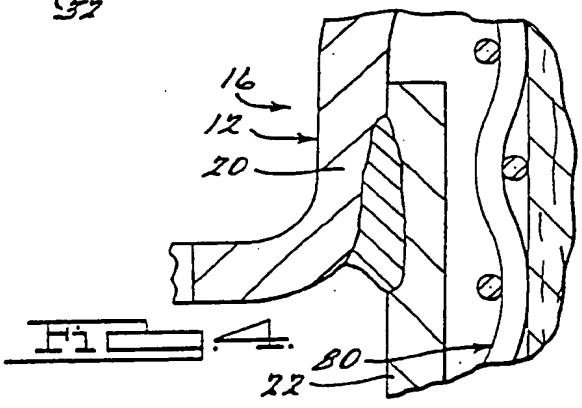


Fig. 4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/03839

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B 60 R 21/26
US CL :280/736; 422/164
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 280/736, 737, 740, 741, 728R; 422/164, 165, 166; 102/530, 531

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	UK, A, 2,022,194 (Nilsson) 12 December 1979, page 2, line 42- page 4, line 12.	1
Y	US, A, 5,004,586 (Hayashi et al) 2 April 1991, col. 2, line 56.	1
A	US, A, 4,131,299 (Ono et al) 26 December 1978.	1
A	US, A, 4,278,638 (Nilsson et al) 14 July 1981.	1
A	US, A, 4,017,100 (Gehrig et al) 12 April 1977.	1
A	EP, A, 488,937 (Albrecht et al) 3 June 1992.	1

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US, A, 3,986,456 (Doin et al) 19 October 1976.	1